RESEARCH DEPARTMENT

ACOUSTIC TESTS IN THE SOUND RECORDING STUDIO, RIVERSIDE

Technological Report No. B-089/6
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SUMMARY

A new control cubicle was recently constructed for the Sound Recording Studio at Riverside, and the studio itself was provided with additional curtains and a carpet. Reverberation times, sound insulations and noise levels were measured in these areas, and this report gives the results of the measurements and discusses their implications.

1. INTRODUCTION

Since previous measurements in this studio were made in 1954, a curtain completely covering the wall at the stage end of the studio has been hung to improve the appearance, the floor has been provided with 54 m^2 of carpet, and hessian has been hung on the remaining walls in the spaces between the vertical cylindrical diffusers. Acoustic measurements were made to determine the changes in the studio resulting from the above modifications, and to assess the acoustic properties of the new cubicle.

2. MEASUREMENTS

This section gives the results of the investigation and discusses their implications.

2.1. Reverberation Time

The reverberation-time frequency-characteristics obtained from measurements in the studio, control cubicle and narrator's booth, are shown in Fig. 1 as curves (*b*), (*d*) and (*e*) respectively. Curve (*a*) shows the reverberation-time frequency-characteristic of the studio in its original condition. Comparison of curves (*a*) and (*b*) indicates that the reverberation-time frequency-characteristic has been substantially improved, the excessive peak centered at 2800 Hz has been greatly reduced, but the dip in the characteristic centered at 500 Hz still exists, as well as the steep rise in the bass end.

The excessive absorption around 500 Hz is probably caused by the plywood hemicylinders, all of the same construction, on the walls and the ceiling which have been a feature of the studio since it was built. The carpet is removable and, to give an indication of the characteristic to be expected when it is taken up, calculations were made to allow for its effects; curve (*c*) indicates the calculated values. The reverberation time at mid-frequencies agrees well with the recommended value for studios of this size.

The reverberation-time frequency-characteristic in the control cubicle is shown in curve (*d*). At frequencies above 180 Hz the reverberation times are too short. The probable reason has been pointed out in an earlier report[1] to be the effect of technical equipment. Curve (*e*) shows the measured reverberation-time frequency-characteristic for the narrator's cubicle. The reverberation times at frequencies above 175 Hz all fall at, or below 0·2 seconds and the narrator's cubicle will therefore provide an acoustic environment for dead speech.

2.2. Sound Insulation

The graphs of sound level reduction from the studio to the control cubicle and from the studio to the narrator's cubicle are shown in curves (*a*) and (*b*) respectively in Fig. 2, which also shows the respective minimum permissible sound level reductions in curves (*c*) and (*d*). The sound insulation between the studio and the control cubicle is insufficient by between 9 dB and 20 dB. This may be caused by the unmodified and badly fitting doors to the short sound lobby connecting the two rooms, and perhaps by incompletely blocked cable ducts between them. The insulation between the studio and the narrator's cubicle also falls short of the minimum requirement, probably due to leakage through the badly fitting single door connecting the two rooms.

2.3. Noise Levels

The noise levels in the studio, cubicle and narrator's booth are shown in Fig. 3, curves (*a*), (*b*) and (*c*) respectively. The noise level measured in the studio with the ventilation plant operating is quite intolerable, exceeding the maximum permissible value by up to 15 dB. It is normal procedure in this studio to switch off the ventilation plant during rehearsals and recordings. The noise levels in the narrator's cubicle and the control cubicle are both unacceptably high but are considerably less than that in the studio.

3. FURTHER TESTS

After the studio had been in service for some months, users complained that it was not possible to obtain enough separation between groups of instruments in multi-microphone recordings of music. This is probably caused by the excessive rise in reverberation in the bass, but was made more noticeable by the addition of the hessian drapes and the consequent reduction of upper-frequency reverberation.

At the request of Television Technical Operations Department, therefore, further measurements were made with the hessian removed. Fig. 4, curves (*a*) and (*b*) show the reverberation characteristics respectively with the carpet rolled back to one end and laid out.

The opportunity was also taken to examine the behaviour of the plywood hemicylindrical diffusers which were suspected of causing the persistent dip at 500 Hz in the reverberation characteristic. An accelerometer was attached to representative diffusers in turn and the studio was excited by tone from a loudspeaker. A few widely spaced resonances were found in the diffusers at frequencies up to 400 Hz and numerous others in the band 400 Hz to 600 Hz, above which there were no significant resonances.

The low-frequency resonances had Q values of about 30, measured by determining the frequencies at which the vibration was 3 dB below peak while the strongest of the resonances in the band 400 - 600 Hz had a Q value of 8. These values would indicate strong absorption around 500 Hz and possible re-radiation at the low resonance frequencies.

4. RECOMMENDATIONS

For a studio of volume 1350 m^3 a suitable reverberation time is 0·6 secs. The acoustics of the studio could be improved by removing absorption around 500 Hz and adding extra absorption at low frequencies. This could be achieved by replacing the plywood hemicylinders by flat panel or membrane absorbers. The control cubicle could be improved by removal of absorption but this is not urgent. The main effect of the excessive absorption will be to cause listening conditions to vary with distance from the axis of the loudspeaker. The narrator's booth requires no modification.

Sound insulation between the studio and control cubicle requires improvement by attention to door seals and cable duct filling.

The ventilation noise in the studio is shown in Fig. 1. This noise should be reduced to produce an improvement of at least 10 dB; if this cannot be obtained, the procedure of switching off the ventilation during rehearsal and transmission will have to continue.

These measurements have been passed on to Building Department so that when money is available, the necessary action may be taken.

5. REFERENCE

1. BBC Research Department Technological Report No. B-089/2 Section 3.

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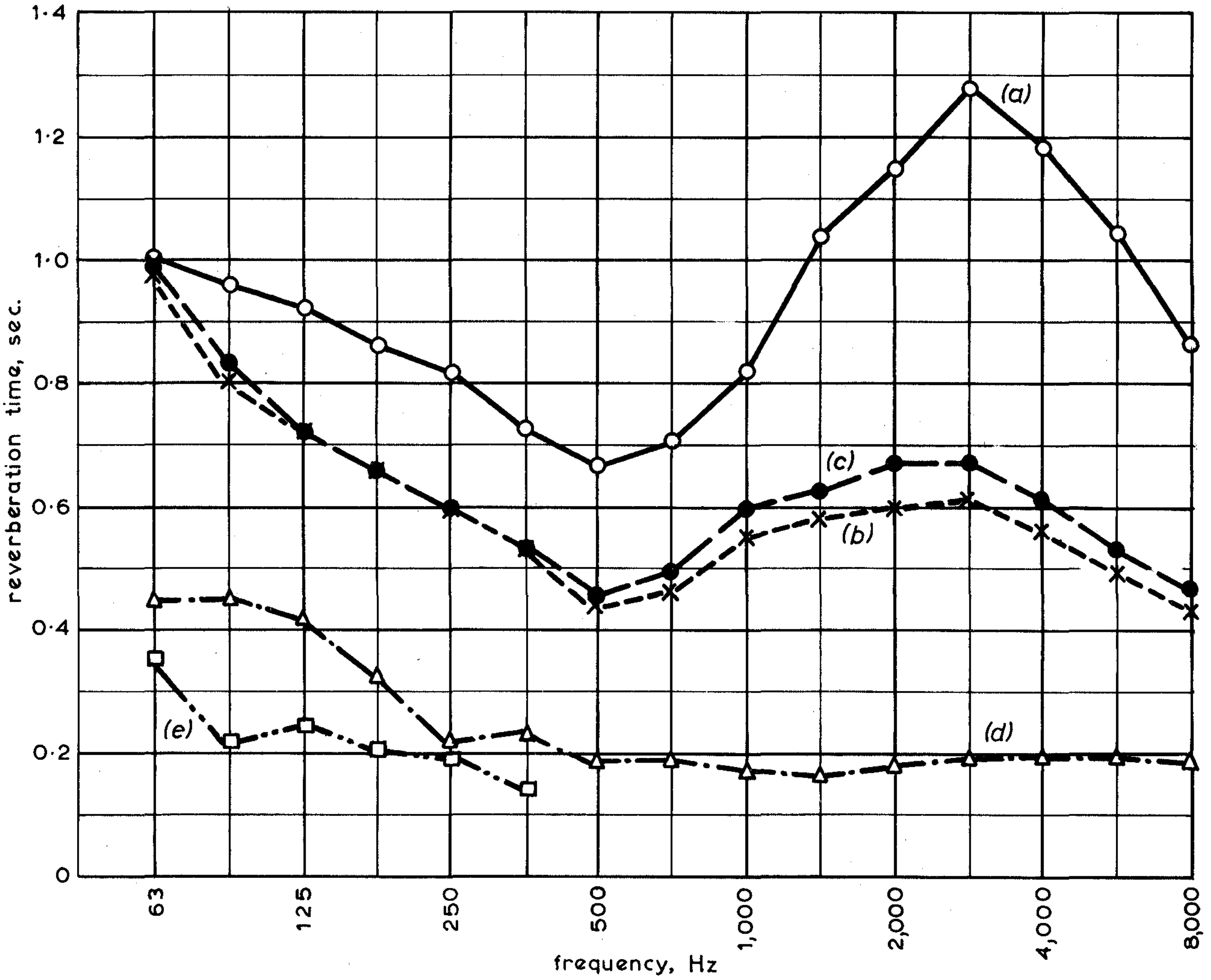

Fig. 1 Riverside recording studio. Reverberation time characteristics.

(a) Measured in 1954.
(b) Measured after refurbishing 1966, with carpet on floor.
(c) Calculated from curve (b) after making allowance for the removal of the carpet.
} studio

(d) Reverberation time characteristic for control cubicle.
(e) Reverberation time characteristic for narrator's booth.

Volumes: studio 1,350m^3, cubicle 76·4m^3, narrator's booth 14·2m^3.

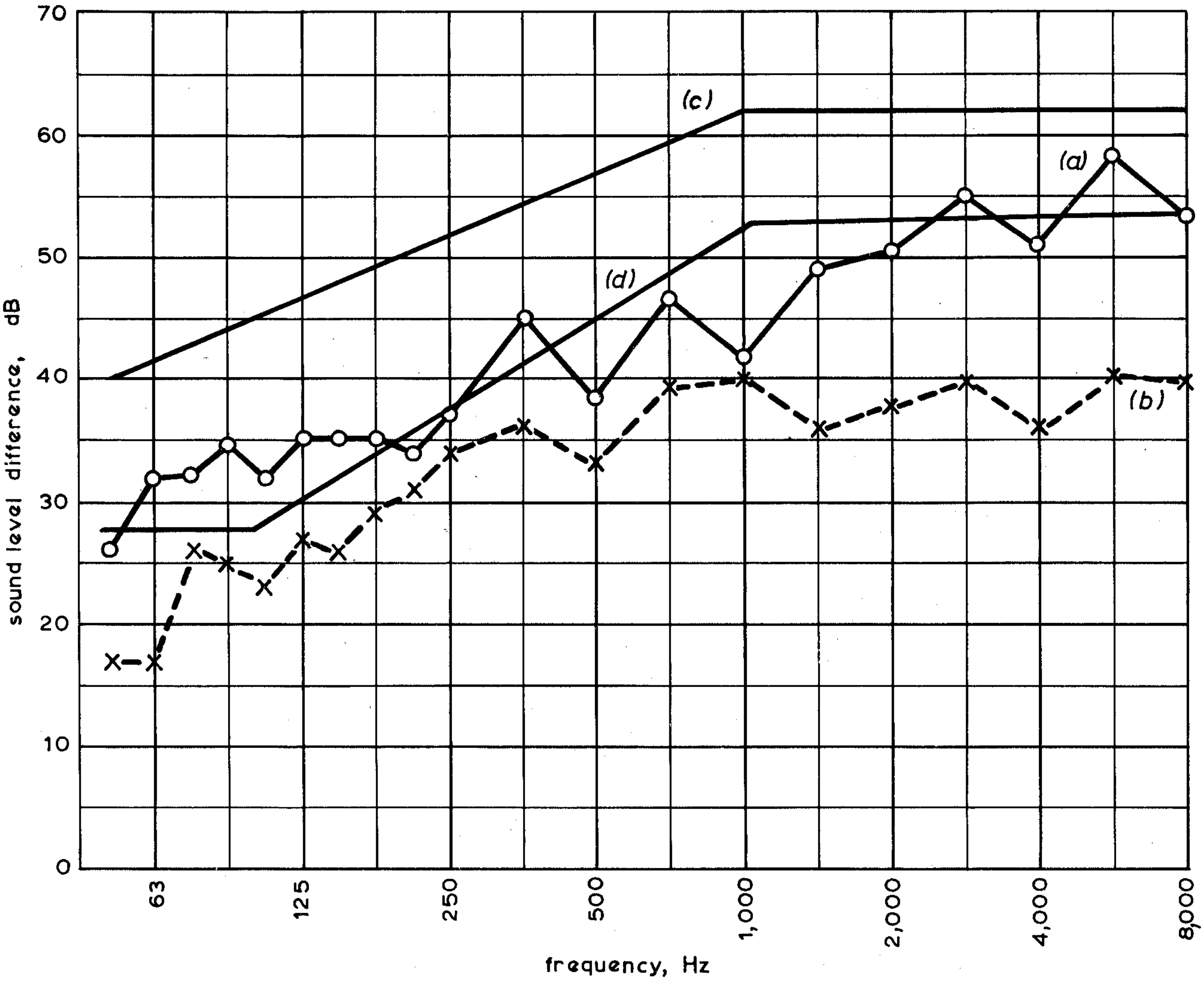

Fig. 2 Sound level differences.

(a) Studio to control room.

(b) Studio to narrator's booth.

(c) Criterion, studio to cubicle monitoring replayed sound.

(d) Criterion, studio to narrator's booth.

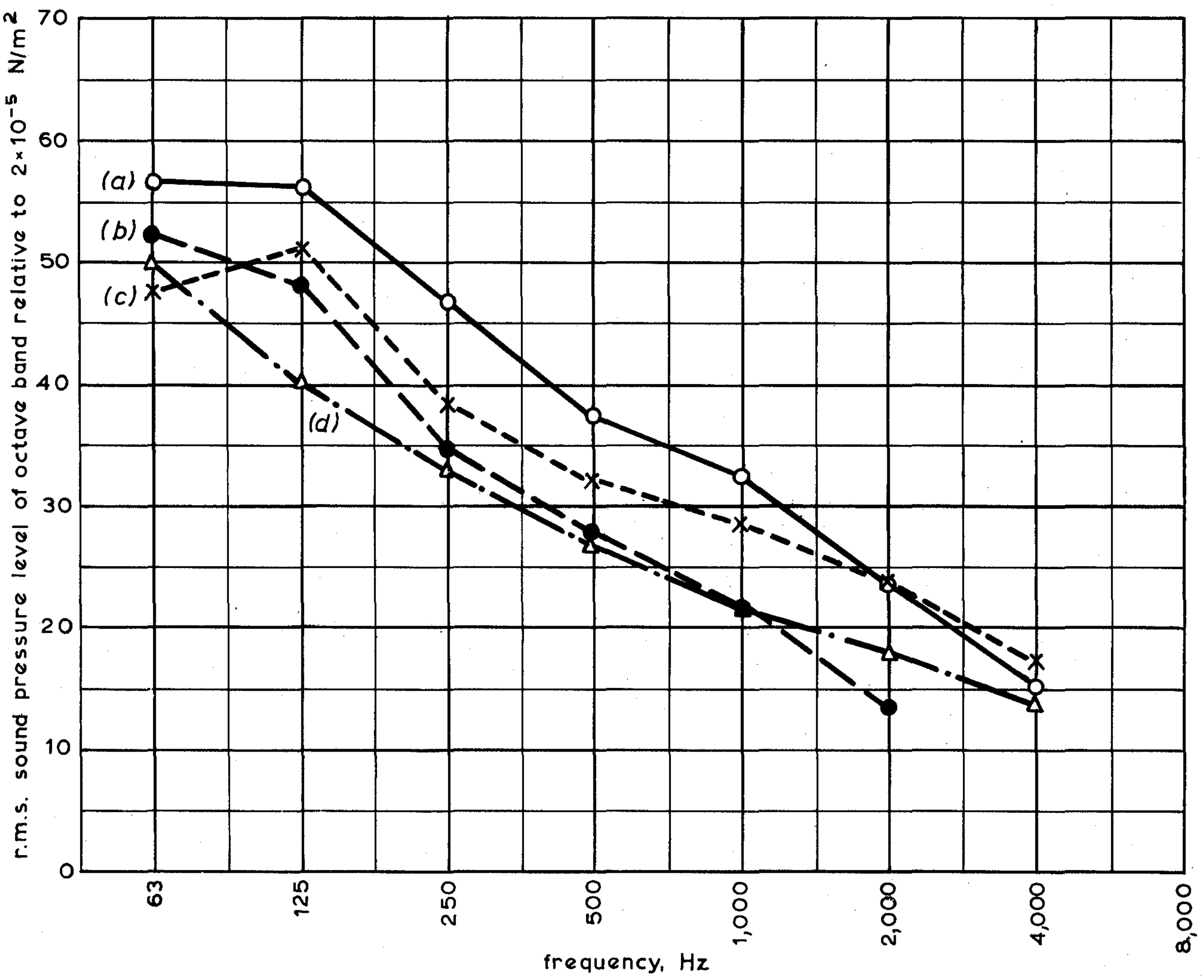

Fig. 3 Octave band analysis of background noise.

(a) Studio

(b) Control cubicle

(c) Narrator's cubicle

(d) Maximum permissible

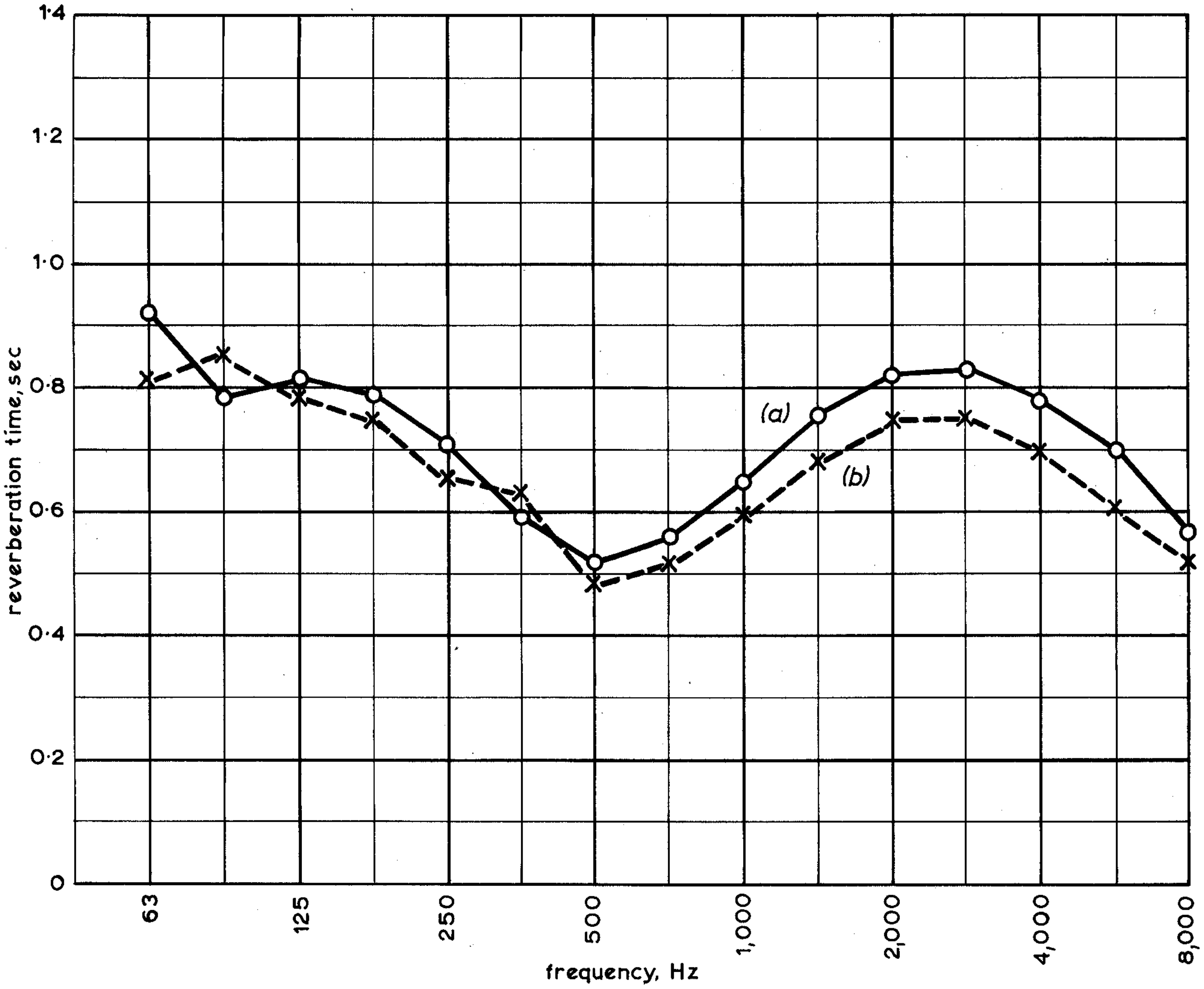

Fig. 4 Riverside recording studio. Reverberation time characteristics

(a) All drapes, except those on stage wall, removed, carpet rolled up.

(b) Carpet laid, all drapes, except those on stage wall, removed.

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